Working Copy

Calculation Cover Sheet

1. Calculation Title: Excess Cancer Risk for the February 14th contamination release, Rev. 1			2. Page: 1 of 4
3. System:	4. AR No.:	5. ECO No.:	6. Functional Classification:

7. SOURCE OF DATA

1. WIPP Labs Report
2. NRCP 116
3. American Cancer Society Facts and Figures 2014
4.
5.

8. SOURCE OF FORMULAS

1.
2.
3.
4.
5.

9. REFERENCES

No.	Drawing No.	Rev. No.	No.	Drawing No.	Rev. No.
1.			6.		
2.			7.		
3.			8.		
4.			9.		
5.			10.		

10. RECORD OF ISSUES

Rev. No.	CE or Author: Date:	Checked By: Date:	CM Approval: Date:
0	James Willison 3/10/14	TE Goff 3/10/14	Jennifer Henrickson 3/10/14
1	James Willison 3/25/14	TE Goff 3/25/14	Jennifer Hendrickson 3/25/14
	James Willison 3/25/14	Tom Goff	3/25/14

11. COMMENTS

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4. Calculations cont.

Purpose

The purpose of this calculation is to calculate the estimated cancer increase rate at offsite locations based on estimated radiation dose estimates.

Introduction

On February 14, 2014, a continuous air monitor (CAM) alarm at the exit of panel 7 in the underground caused the ventilation at the WIPP to shift over to HEPA filtration. Subsequent measurements of the effluent (Station B), using representative sampling, demonstrated that a release had occurred.

Inputs

Rev 1. Estimates of dose at offsite locations are calculated based on radiochemistry data from WIPP Laboratories [WIPP Labs 2014]. This data is shown below as Table 1 of this Calculation:

Table 1. WIPP Lab Final Report on Offsite Filters

EM Sample ID	WIPP LABS ID	Date Collected	Time Collected	Pu239/240 (DPM/SAMPLE)	Pu-239 MDC (DPM/SAMPLE)	Am-241 (DPM/SAMPLE)	Am-241 MDC (DPM/SAMPLE)
AL-WFF-20140212-1.1	C7840	2/15/2014	12:00	3.67E+00	5.94E-01	4.88E+01	5.05E-01
AL-WSS-20140212-1.1	C7892	02/17/14	14:04	1.28E-02	4.25E-02	1.41E-01	4.40E-02
AL-WEE-20140212-1.1	C7893	02/17/14	14:33	3.08E-02	4.27E-02	5.73E-01	4.27E-02
MILLS RANCH	C7901	02/18/14	10:00	2.58E-03	4.24E-02	1.57E-02	4.63E-02
SMITH	C7902	02/18/14	9:17	1.38E-02	4.61E-02	2.44E-01	4.69E-02
CARLSBAD	C7903	02/18/14	8:34	6.09E-04	4.66E-02	2.23E-02	4.60E-02
SE CONTROL 1 of 2	C7904	02/18/14	10:28	-3.29E-03	4.38E-02	2.95E-02	4.67E-02
SE CONTROL 2 of 2	C7905	02/18/14	10:37	1.14E-02	4.81E-02	2.12E-02	4.62E-02

Results

Measured activity for Pu-239/240 for all samples except the Far Field location were less than the Minimum Detectible Activity [MDA.] Measured activity for Am-241 was only above the MDA at the Far Field, South, East, and the Smith Ranch locations. The Mills Ranch, Southeast Control, and Carlsbad locations were less than the MDA.

Measured values in dpm per sample, x, were converted to airborne concentrations using Eq. 1

$$x\ dpm \times \frac{1\ Bq}{60\ dpm} \times \frac{1\ uCi}{3.7E4\ Bq} \Big/ \left(8\ hrs \times 2\ \frac{ft^3}{min} \times \frac{60\ min}{hr} \times \left[\frac{30.48\ cm}{ft}\right]^3\right) = y\frac{uCi}{cm^3} \qquad \text{Eq. 1}$$

This value can then be converted into dose using Equation 2.

$$y\frac{uCi}{cm^3} \Big/ \left(5E-12\frac{uCi}{cm^3}/DAC\right) \times 8\ hrs \times \frac{2.5\ mrem}{DAC-hr} = z\ mrem \qquad \text{Eq. 2}$$

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4. Calculations cont.

Values for the Far Field location are the sum of the doses from Pu-239/240 and Am-241.

The calculated doses are shown in Table 2.

Table 2. Dose estimates using 8 hour exposure times

	Far Field	South	East	Smith Ranch
Am-241 (dpm)	48.8	0.14	0.57	0.24
Pu-239/240 (dpm)	3.67	--	--	--
dose estimate (mrem)	3.46	0.01	0.04	0.02

There were no measured results above the MDA at the Mills Ranch, Southeast Control, or Carlsbad locations.

Offsite locations are shown in Figure 1.

Radiation risk factors are taken from Publication 116 of the National Council on Radiation Protection and Measurement (NCRP)[NCRP 1993]. The published risk factor for members of the public is 0.05 fatal cancers per Sievert to the general population. This translates into 1 latent cancer fatality per each 2000 rem of exposure. It should be noted that the NCRP risk factors are only for use with populations and not for calculation of individual risk.

The dose estimates were adjusted by the risk factor with the results listed in Table 3.

Table 3. Increased Individual Cancer Risk Estimates using 8 hour exposure times

	Far Field	South	East	Smith Ranch
dose estimate (mrem)	3.46	0.01	0.04	0.02
Increased number of cancers	2E-6	5E-9	2E-8	9E-9

For clarity, an increased risk of 2E-6 means 1 additional cancer fatality might be attributable to the radiation dose if 500,000 people were at that location and received 3.46 mrem each.

For comparison, the American Cancer Society reports the Probability of Developing Invasive Cancers (Birth to Death) of 43.9 percent for males and 38.0 percent for females [ACS 2014], or approximately 200,000 of the 500,000 compared to the potential for this 1 additional fatality.

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4. Calculations cont.

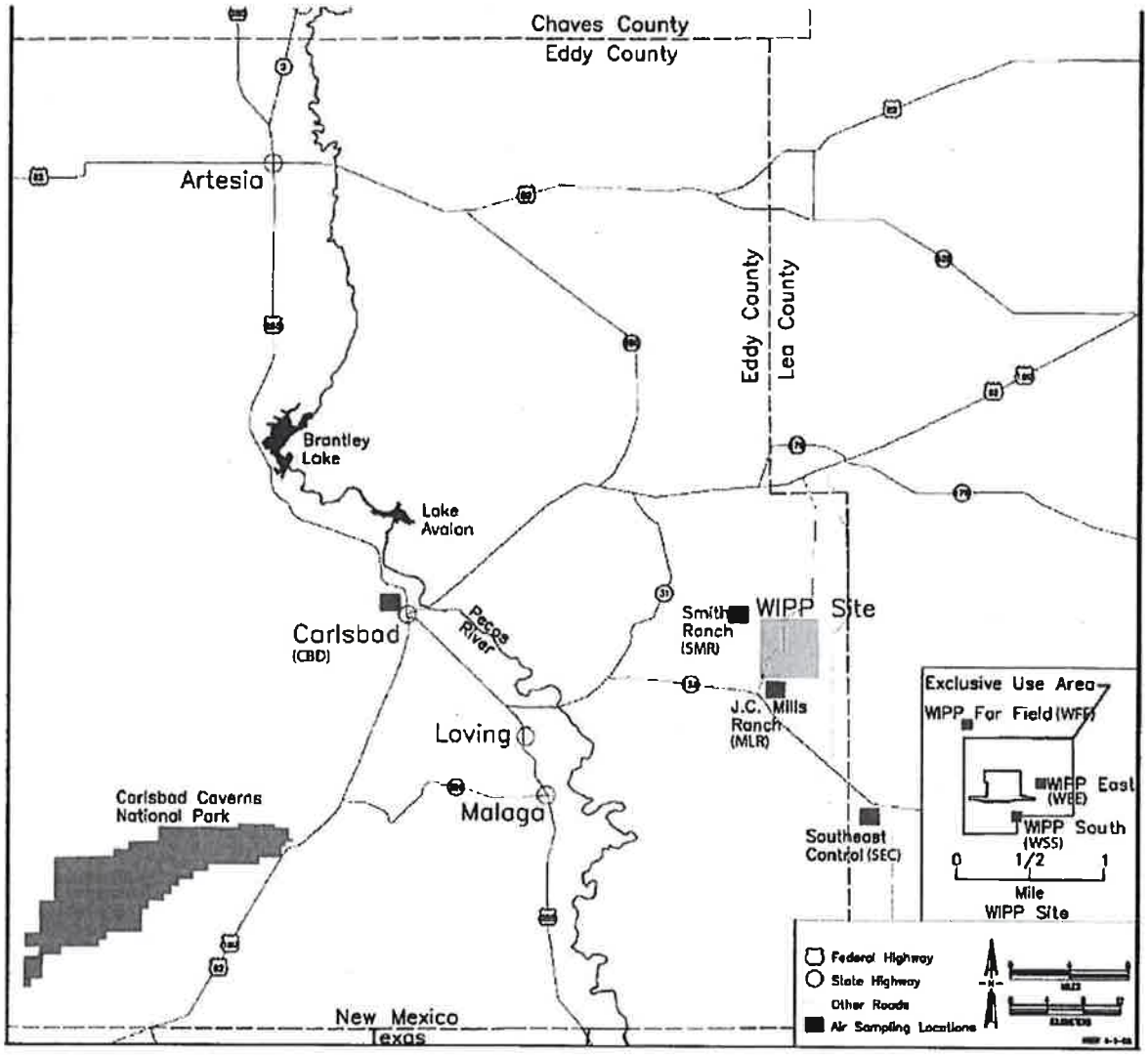

Figure 1. WIPP offsite air sampling locations as marked by red squares. The inset in the lower right shows additional scale surrounding the WIPP vicinity. The upper scale in the lower right corner of the figure is in units of 4 miles. The bottom scale in the lower right is in units of 4 km. This figure was taken from the 2011 ASER (DOE/WIPP-12-3489).

Conclusions

The bounding value for the increase in latent cancer fatalities is 2E-6/individual.

References

1. WIPP Labs Report of Air Samples, 2014.[WIPP Labs 2014]
2. NCRP Publication 116, Limitation for Exposure to Ionizing Radiation, National Council on Radiation Protection and Measurements, Bethesda, MD, 1993. [NCRP 1993]
3. Cancer Facts and Figures 2014, American Cancer Society [ACS 2014]

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